THE WALTER AND ELIZA HALL INSTITUTE OF RESEARCH IN PATHOLOGY AND MEDICINE

THE DIRECTOR'S SIXTEENTH ANNUAL REPORT 1934-35


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Melbourne:

Spectator Publishing Co., 134a Little Collins Street, Melbourne.

1935

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The Director's Sixteenth Annual Report

TO THE BOARD

OF THE

Walter and Eliza Hall Institute of Research

IN PATHOLOGY AND MEDICINE.

JULY, 1935.

The most important advance in our work this year has been the development of research on virus diseases, carried out under grants from the Rockefeller Foundation and from the Health Department of the Commonwealth Government. Financially, the position of the Institute is still unsatisfactory, and further funds are badly needed. This year, for the first time since 1930, we have balanced our expenditure and income, but this is due to a variety of causes, some of which will not operate permanently. The virus funds have relieved the general fund of much of the expense of maintenance of Dr. Burnet's department, and the cost of the collection of snakes and their venom is no longer being borne by the Institute. Our senior staff is still being paid at reduced rates of salary, and extreme economy is still necessary in the general expenditure for materials and apparatus. Unless further help is forthcoming, our work will continue to be greatly hampered.

There have been some changes in the Board of the Institute. It is a pleasure to welcome our new Chairman, Mr. Arthur Baillieu, who has taken the place of Mr. J. A. Levey as President of the Royal Melbourne Hospital. We are very grateful to Mr. Levey for his interest in the Institute, and shall miss him greatly. Mr. A. M. Nicholas, unhappily, had a serious illness last year, and has had to obtain a year's leave of absence from the Board. We have been extremely fortunate in inducing Mr. Russell Grimwade to take his place. We are very glad to welcome the new Vice-Chancellor of the University, Dr. R. E. Priestley, to the Board, and, at the same time, we are sorry to lose Sir James Barrett, the Deputy Chancellor, whose interest in the Institute has been continuous since its inception.

The Staff of the Institute.

Dr. Basil Kilvington, since his retirement last year from the Honorary Surgical Staff of the Melbourne Hospital, has been working in an honorary part-time capacity in my department. He has returned to the problem of nerve regeneration, in which he was one of the pioneers.

Mr. D. H. Le Messurier has been working with me in an honorary capacity since January of this year. He will shortly be going to America to gain further research experience.

Dr. Lucy Bryce, who, at the end of July, 1934, resigned her post as clinical pathologist to the Melbourne Hospital, has since been working in an honorary capacity in Dr. Burnet's department.

During a large portion of this year we have had with us as guests of the Institute in the department of virus research Dr. A. W. Turner, D.V.Sc., Director of the Council for Scientific and Industrial Research Laboratories at Townsville, Queensland, and Dr. Esmond V. Keogh, of the Laboratories Division of the Commonwealth Health Service.

Dame Jean Connor joined us on 1st. February of this year as a part-time field worker in connection with the researches on virus disease. She has since been honoured by His Majesty the King for her work on behalf of crippled children.

Miss Phyllis Rountree was appointed in August, 1934, to a research fellowship in the department of virus research, and Miss Dora Lush, who was working with Dr. Burnet under a University Research Scholarship, was appointed to a research fellowship in the same department in January, 1935.

In August, 1934, Dr. Ivan Connor, owing to the pressure of increasing practice, was unable to continue as an Elsie Marion Carty Research Fellow. Dr. Eric Cooper also resigned his Fellowship at the end of March, 1935, having been appointed Stewart Lecturer in the University Department of Pathology. Dr. Ian Wood was appointed Elsie Marion Carty Fellow on 1st. April, 1935.

Department of Virus Research.

Psittacosis in Australian Parrots.

At the request of the Commonwealth Director General of Health, Dr. Burnet has undertaken a survey of the incidence of psittacosis in Australian parrots. Psittacosis virus was isolated from the first consignment of birds examined, and subsequent work showed that a surprisingly high percentage of parrots were infected. The most important finding is that certain

species are naturally infected with psittacosis in the wild state. Freshly caught specimens of the following species have been found to harbour typical psittacosis virus: Red-backed Grass Parrot (*Psephotus haematonotus*), 18 positive in 45 individuals examined; Cockatiel (*Leptolophus hollandicus*), 2 positive in 6 examined; Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*), 4 positive in 6 examined; Rainbow Lorikeet (*Tr. molluccanus*), 3 positive in 6 examined; Galah (*Kakatoe roseicapilla*), 1 only positive in 33 examined.

Infected examples of Budgerigars (*Melopsittacus undulatus*) and Rosellas (*Platycercus eximus*) have been obtained from dealers, but not in specimens known to be freshly caught.

In general the conditions amongst our wild birds seem to be closely comparable with those encountered by Meyer and Eddie in Budgerigars from Californian aviaries. There is a high proportion of infections, mostly symptomless, particularly amongst younger birds. Meyer and Eddie found that older birds which had once been infected with the virus were often non-infective, although they retained the large spleen characteristic of infection with the virus. We have frequently encountered large spleens in parrots from which no virus could be isolated, and for which no other obvious cause could be seen. It is probable that these large, non-infective spleens may be taken as evidence of past psittacosis. If we combine the figures for the commoner species, irrespective of whether they were obtained from dealers or from "the bush," to show the three groups, some interesting points appear.

Genus	Proved Psittacosis		Enlarged Spleen not Infected		Normal Spleen		Total
Psephotus	28	41%	4	6%	36	53%	68
Melopsittacus ..	1	5%	1	5%	21	90%	23
Platycercus	5	5%	17	18%	71	76%	93
Trichoglossus . ..	7	58%	2	17%	3	25%	12
Leptolophus	6	60%	0	0	4	40%	10
Kakatöe	3	6%	10	21%	34	72%	47

It will be seen that the grass parrots were very heavily infected, relatively few enlarged spleens failing to infect mice; the Rosellas (several species) often showed enlarged spleens, but these were usually free of demonstrable virus. The only positive examples were obtained from dealers, 59 recently caught birds all being negative. The Cockatoos (Galahs and Sulphur Crests) showed the same type of behaviour as the Rosellas. Unfortunately it was not possible to determine the ages of the

birds, and it is possible that these differences may be related to differences in the ages of the samples examined, rather than to species differences in their reaction to infection.

During the period of the investigation there have been apparently few deaths of parrots from psittacosis. Three dead birds have been received—two Galahs and one Grass Parrot—which had clearly died of the infection, and from which active strains of virus were isolated. A number of other sick or dead parrots and cockatoos were examined with negative results. No human cases have been observed.

In addition to the routine survey of parrots for infection, certain experimental work has been carried out with the virus. The virulence of different strains for mice has been compared, and the pathological findings studied. The lesions produced by local virus strains correspond closely to those described for strains isolated in Europe and America during the epidemic of psittacosis in 1929-30. Primary inoculations, however, have rarely produced definite parenchymatous liver lesions. The characteristic feature of Australian virus is to produce large amounts of fibrinopurulent exudate in the peritoneal cavity, and with active strains also in the pleural cavity. The liver is frequently coated with a white sheet of inflammatory lymph, the cells of which contain numerous L.C.L. (virus) bodies. When a few successive mouse passages are made, most of the strains increase in virulence, and, particularly in young mice, induce typical necrotic patches in the liver substance.

The virus has been successfully cultivated on the chorio-allantoic membrane of the developing egg, and in this situation provides very suitable material for a study of the important developmental changes in the morphology of the virus which have been described by Bedson and Bland.

Despite its apparent low virulence the Australian virus when inoculated intratracheally into monkeys produces a severe illness with characteristic pneumonic changes in the lungs. Although rats are not obviously affected by intraperitoneal, intracerebral or intrapleural injection of the virus, instillation into the nose of the anaesthetised rat produces an acutely fatal psittacosis pneumonia. These findings suggest that the local virus is capable of producing disease in man, and that cases will be detected in Australia if the possibility is borne in mind by medical practitioners.

Louping Ill.

In a communication to the Australian and New Zealand Association for the Advancement of Science, Dr. Burnet elaborated the hypothesis that Australian X disease was due to

infection by louping ill virus. It was hoped during the past year that sera might be obtained from individuals who had recovered from the disease, and tests made for their ability to inactivate louping ill virus. Unfortunately it has so far proved impossible to obtain such sera. A number of sera from cases of nervous disease of recent date, which might possibly have been of a similar nature to X disease, have been tested with negative results. Arrangements are being made to test sheep sera from various parts of Eastern Australia, to see whether any evidence of louping ill being still enzootic can be obtained.

The resemblance of louping ill in sheep to human poliomyelitis has impressed a number of observers. In the hope that it may throw some light on the pathology of the latter disease, Dr. Burnet is investigating a form of inapparent infection by louping ill in the rat. If louping ill virus in the form of mouse brain emulsion is instilled into the nose of the rat no symptoms appear, but suitable experiments show that the virus passes into the olfactory lobes of the brain without spreading further in the central nervous system. A moderate amount of multiplication appears to occur in the olfactory lobe, and there is a transient invasion of the blood. Subsequent to this infection the rat serum, normally without action on the virus, develops antibodies capable of inactivating the virus. In all essential respects this phenomenon parallels what most workers regard as the method by which asymptomatic infection with poliomyelitic virus occurs in children, and produces the specific antibodies found in most adults' serum.

The Growth of Viruses on the Chorio-allantoic Membrane of the Developing Egg.

This technique has been extensively employed during the past year by Dr. Burnet, with the collaboration of Miss Lush and Miss Rountree. In addition to the viruses previously known to develop in this situation, two further viruses have been shown to produce characteristic lesions—those of psittacosis and mouse ectromelia.

Psittacosis.—The lesions produced by this virus have an entirely different structure from any so far examined, and have provided much interesting histological material. The development of the lesion and the distribution of the characteristic virus bodies have been followed by smears and sections, and many experiments have shown the indefinite transmissibility of the virus from egg to egg. The virus infects the superficial ectodermal cells of the chorio-allantoic membrane and multiplies within them. The first cells to be infected appear to necrose

early and liberate the virus to infect adjacent cells. In this second generation of infected cells the virus particles assume first the large form described by Bedson and Bland, and then with further multiplication give rise to cells crowded with small typical virus bodies. As this process goes on there is further ectodermal multiplication and an invasion of leucocytes into the neighbourhood of the infected cells. The affected ectoderm becomes differentiated into two layers, an outer necrosing layer permeated with leucocytes and containing on its surface the packed "virus cells," and an inner uninfected layer which thickens and cornifies. About the third or fourth day after inoculation the outer layer becomes completely necrotic and is cast off, leaving a thickened but uninfected membrane.

The egg is not so sensitive an indicator of the presence of virus as the mouse, and only in exceptional instances does it show lesions after inoculation of spleen emulsion from parrots which are chronic carriers of the virus. No change in virulence for mice has been noticed after frequent egg passage.

Ectromelia.—The fact that this virus will multiply on the egg membrane is of interest, since as far as is known it is highly specific for the mouse and is not infective for any other animal. When the egg is inoculated with a fresh emulsion of liver from an animal showing definite symptoms and early liver necrosis, a profuse lesion develops in sections of which great numbers of typical large inclusion bodies can be found. Incubation with filtrates of sub-inoculations from egg membranes do not give such obvious lesions, but the virus can be passaged for at least four generations without loss of virulence for mice. The lesions show a considerable resemblance to those of psittacosis, and like these are rapidly segregated and cast off by the cornifying membrane. As an example of a virus which is of only a low grade of virulence for the egg, the reactions are being studied in detail as perhaps capable of indicating how best the developing egg technique can be utilised in the search for hitherto undetected viruses.

Poliomyelitis.—This virus is said by Gildemeister to be capable of growth in tissue culture using chick embryo tissue. If so, it should also be capable of infecting the chick membrane. In view of the potential importance of a new experimental method of detecting poliomyelitis virus, a careful trial of the egg membrane method was made with an active monkey strain (M.V.) of virus. A number of different methods were tried, using eggs of different ages and with or without fresh nervous tissue from another embryo. No positive results whatever were obtained.

Louping Ill.—Louping ill virus was found by Burnet and Galloway to be capable of multiplying in the egg, but not of producing any characteristic lesion beyond a variable liver necrosis. Further work has shown that using 12 day embryos and opening the egg two days after inoculation, small but characteristic focal lesions, whose number bears a close relationship to the concentration of virus added, can be observed on the membrane. Addition of immune serum prevents the appearance of these lesions. The method appears to have potentialities as a rapid means of titrating virus or virus-neutralising antibodies.

Particularly with younger embryos an interesting disease condition of the embryo appears four or five days after inoculation, which is characterised by pallor often with a slight yellowish tint, oedema of the skin and body wall, greenish discoloration of the liver often associated with gross necrotic changes, and evidence of excessive liberation of bile pigment into the upper part of the intestine. Blood smears show appearances which make it likely that these signs are chiefly manifestations of an acute haemolytic anaemia due to the general virus infection.

Both these findings indicate that although louping ill virus has usually been regarded as neurotropic in its effect on the usual experimental animals, it is a much more viscerotropic virus in the developing embryo.

Influence of Age of Egg on the Types of Lesion Obtained.

In an attempt to improve the reproducibility of egg membrane virus titrations, eggs were inoculated at intervals from the seventh to the thirteenth day after the commencement of incubation. Nearly all the available viruses have been tested in this fashion with results that are very similar in each instance. The differences between younger and older eggs may be summarily stated as follows: In younger eggs (a) non-specific traumatic lesions are common, (b) individual virus foci on the membrane are larger but fewer in number, (c) histologically the lesions tend to be more diffuse with defensive processes less in evidence, (d) generalisation occurs more readily and death of the embryo (with lethal viruses) occurs earlier.

In older twelve or thirteen day eggs (a) non-specific lesions are rare and if present slight, (b) the individual virus foci are smaller but often much more numerous, (c) histologically the lesions tend to be limited to the ectodermal layer and in several instances the virus-infected cells are rapidly segregated and destroyed, (d) generalisation is slower and death is delayed.

In addition the older eggs provide a larger air space, and hence a greater area of susceptible surface over which the virus can be spread. The results with twelve-day eggs, largely owing to the absence of non-specific lesions, are more readily reproducible, and we have now adopted this age as the standard one for inoculation, when the type and number of the membrane lesions are being looked for.

With many of the viruses which develop on the chorio-allantoic membrane, the number of foci obtained is roughly proportional to the concentration of virus, and in the case of vaccinia and louping ill the susceptibility of the egg appears to be at least as great as that of the usual test animal. Previous work at Hampstead showed that for vesicular stomatitis virus the egg was much more susceptible than the guinea pig pad, and that it was at least as susceptible as the half-grown chick to the viruses of fowl plague, Newcastle disease, and laryngo-tracheitis. It appears reasonable to take as a working hypothesis that under the best conditions one active particle of virus is capable of initiating a focal lesion on the embryo membrane. The value of what is essentially a "plating method" for viruses analogous to that used in bacteriophage technique would be very great if quantitatively reproducible results could be obtained. So far we have not been satisfied that sufficiently reproducible results can be obtained to make the method available for attack on specific problems. The use of older eggs has made a considerable improvement in the results, and we are hopeful that further experience will allow the method to become a practical one.

Infectious Laryngo-tracheitis of Fowls.

A valuable demonstration of the practical value of the egg-membrane technique was afforded by an outbreak in New South Wales of a disease of poultry resembling infectious laryngo-tracheitis. Material from tracheal lesions was provided by Dr. H. R. Seddon, Director of Veterinary Research in New South Wales. By suitable inoculations into developing eggs it was shown to contain a virus producing macroscopically and microscopically the typical lesions of laryngo-tracheitis virus. The lesions on the second day are of quite characteristic appearance, and histological examination shows the striking intranuclear inclusions which are diagnostic for this disease. With this technique it was therefore possible to make a presumptive diagnosis within two days, and a final one within a week of receiving the material. It is worth noting that the infectious diseases of fowls known to be due to viruses, fowl plague, Newcastle disease, fowl pox, and laryngo-tracheitis have all

distinct and characteristic pathogenic effects on the egg membrane, which will allow a rapid diagnosis in cases where there is some doubt as to the clinical condition.

Study of the egg lesions produced by this virus is being continued, and experiments are being planned in collaboration with Dr. Seddon to see whether the technique can be usefully applied to epidemiological and immunological study of this infection.

Contagious Pleuro-pneumonia of Cattle.

During his stay at the Institute Dr. Turner carried out a study of the effect of the organism of contagious pleuro-pneumonia when inoculated on to the chorio-allantoic membrane. Cultures produced definite changes in the membrane and the organism multiplied to a moderate extent, but no specific histological changes could be determined. The effect was apparently merely an accentuation of the non-specific inflammatory changes present in all membranes subjected to the technique in use. Dilution of culture gave no indication of any focal distribution of lesions. The whole response was quite unlike that to any typical virus, and perhaps affords another argument for the growing opinion that the organism of contagious pleuro-pneumonia has very little in common with the true viruses.

Staphylococcal Toxins.

In view of the work carried out in this Institute on staphylococcal toxins after the Bundaberg disaster of 1928 by the Royal Commission and by Dr. Burnet, it is of interest to note that an International standard of potency for staphylococcal antitoxin has now been accepted by the Biological Standards Commission of the League of Nations. Along with a number of other workers in various countries, Dr. Burnet assisted in testing the suitability of the standard proposed by Hartley and Llewellyn-Smith of the National Institute for Medical Research.

Certain workers consider that more than one toxin is present in toxic filtrates of staphylococci from human sources. In addition to the classical toxin, whose activities are best tested against the cells and tissues of the rabbit, another toxin lysing the red blood cells of the sheep has been postulated. Dr. Burnet and Dr. Lucy Bryce found that filtrates from certain bovine strains of staphylococci behave as if they contained only this second toxin. Dr. Bryce and Miss Rountree are now engaged on cultural and immunological studies of this toxin and its relation to the classical toxin.

Staphylococcal Bacteriophages.

Miss Lush has completed a study of the classification of staphylococcal phages, using the methods employed in previous work on the dysentery phages. Staphylococcal phages are much rarer in nature than those lysing intestinal bacteria, and the number of types found correspondingly smaller. As with the intestinal phages, the immunological criterion was found to be the most satisfactory one for classification. Three serological types were found amongst the phages lysing aureus strains of human origin, and three others amongst phages lysing a highly susceptible white coccus S.F. which had been studied previously by Burnet and McKie. Great difficulty was experienced in obtaining resistant variants, and cross resistance tests were found to be impracticable. This difficulty was correlated with the very slight antigenic variability found in staphylococci. A number of close analogies with certain of the coli-dysentery phages were recognised, and it was concluded that the staphylococcal phages are very similar biological units, and that the processes of lysis, etc., are essentially similar except in so far as they are modified by the very stable antigenic structure of the staphylococci.

This work was intended to be preliminary to a study of the staphylococcal antigens, utilising the phage-inhibiting activity of extracts and fractions as a guide to their isolation and study. Miss Rountree and Miss Lush have found that crude extracts and filtrates contain phage-inhibiting agents, which behave like those produced by the dysentery bacilli. Attempts to purify these extracts have been unsuccessful, the great bulk of the activity being removed by any protein precipitant so far tried, and for the time being this work has been dropped.

Structure of Bacterial Antigens.

Dr. Burnet has utilised the phage-inhibiting activity of bacterial extracts for some experiments bearing on the immunological problem of the nature of the relation between antigens which show partial cross reactions. The various types of Flexner dysentery bacilli present a classical example of serological relationship. The most generally adopted view is that each type carries a "mosaic" of antigens, some of which are common to other types. Previous work having shown that the phage-inhibiting activity could be used as a delicate measure of the amount of specific bacterial antigen (complex polysaccharide) in a given solution, the experiments consisted essentially in examining the amount of soluble antigen remaining after reaction with different antisera had been completed. The results indicated that although an antiserum can be readily

fractionated by immunological manipulations into what appear to be distinct antibody components, no such fractionation is possible in regard to the bacterial antigen.

This finding confirms work by Landsteiner and Furth carried out along different lines, and it has been discussed in the light of the recent formulation of the theory of antigen-antibody relations by Marrack. It was concluded that the classical "mosaic" hypothesis of antigenic structure is untenable except in a greatly modified form. The antigen molecule is a complex carbohydrate carrying a number of "determinant groups," any or all of which may "impress" a corresponding "pattern" on the globulin molecules, which in the sum make up the antibody of an immune serum. In a single "pure" antiserum therefore there will be differences between the modified globulin molecules in regard to the number and type of the determinant groups with which they are capable of reacting. By absorption with related but heterologous antigens the serum can be fractionated, but since the antigen is composed of uniform but complex molecules no comparable fractionation can be affected by immunological means.

Photodynamic Inactivation of Bacteriophages and Viruses.

As a contribution toward defining the conditions under which bacteriophages and viruses retain their antigenicity after photodynamic inactivation by methylene blue, Miss Lush has been studying representative bacteriophages in this respect. She finds that irradiation of the phages so far studied, for twice the period necessary for complete inactivation, still leaves them capable of producing potent anti-phage sera in rabbits. This holds for a typical staphylococcal phage, and for large, medium, and small-particle dysentery phages. During the course of her work on staphylococcal phages Miss Lush also investigated the protecting effect of living bacteria against the photodynamic inactivation of phage. The results indicated that only those organisms on which the phage could multiply gave protection, showing in all probability that only penetration of the phage within the organism affords protection.

Streptobacillus Moniliformis Infections in Rodents.

Dr. Turner and Dr. Keogh have shown that an infectious arthritis amongst stock mice in another laboratory in Melbourne was due to an organism of the streptobacillus moniliformis type. Similar organisms, which appear to be normal inhabitants of the nasopharynx of the rat, have also been encountered by Dr. Burnet in connection with experiments on psittacosis infection of the rat lung. In view of recent work which

suggests that this organism is a "symbiosis" of a bacillus with a pleuro-pneumonia-like organism, Dr. Turner made a number of attempts to isolate the latter component from these locally-obtained strains, but without success.

Field Investigations at Camperdown.

An outbreak of poliomyelitis in Hampden Shire occurred in March of this year. Dame Jean Connor, who visited the area, was struck by the limitation of the disease to the dairying district, all of the cases occurring in the coastal belt south of the sheep areas, and also by the reports current of associated cases of paralysis among domestic animals.

Equipment for a mobile laboratory was hurriedly assembled, and a motor van capable of transporting the equipment and animals was hired. Our thanks are especially due to Dr. Ivan Connor, who selected a suitable vehicle for us, and to Mr. H. G. Adams and Mr. T. C. Manifold, who contributed the cost of its hire. Dr. E. V. Keogh, of the Laboratories Division of the Commonwealth Health Service, went down to carry out the laboratory investigations. Headquarters were established on 23rd. March at the Showgrounds, Camperdown, where excellent laboratory accommodation was available, as well as suitable pens and stalls for the larger animals. Dame Jean Connor visited Camperdown on several occasions, staying a few days each time, to investigate the cases of infantile paralysis and collaborate with Dr. Keogh in the laboratory work.

The fullest co-operation was afforded by the Hampden Shire Council (to the Shire President, Mr. Russell, we are particularly grateful) and by their Medical Officer, Dr. Edward Varley. The Council placed at our disposal the services of their Health Inspector, Mr. J. W. Smyth; his assistance was invaluable. We are also indebted to the Department of Agriculture for their co-operation, particularly for help afforded in the early stages by Mr. Mountjoy, B.V.Sc., and to Dr. Albiston, Director of the Veterinary Institute, for advice on some aspects of the problems investigated.

Despite the size of the area in which the cases occurred, the limited personnel available, and the fact that the epidemic proved to be practically over at the time when work was commenced, the expedition proved well worth while. Valuable experience was gained in the methods of organising and maintaining a field laboratory, and much local interest was stimulated.

It was realised that it was not practicable to carry out an intensive investigation of any one aspect of the problem under

field conditions, but it was hoped that material for further detailed study might be obtained in the field.

It was not possible to carry out an efficient epidemiological survey, since the epidemic was practically over on our arrival, and information regarding the earlier cases was not wholly reliable. No evidence of direct contact was found by Dr. Varley in any of the cases, except where more than one case in a family occurred. The possibility of indirect contact with frank paralytic cases or with abortive cases could not be excluded. It is perhaps worthy of note that while numbers of families left the district during the epidemic, no cases arose in the areas to which they went. There were no fatal cases, so that we were not able to isolate the local virus.

Attempts at transfer of the human disease to monkeys by intra-cerebral inoculation of blood from pre-paralytic cases were unsuccessful. Blood from six patients was inoculated into five monkeys. None developed paralysis. But, of the patients concerned, one was wrongly diagnosed as poliomyelitis, one was already paralysed when the blood sample was taken, and none of the other four (who had typical symptoms of pre-paralytic poliomyelitis with characteristic changes in the cerebrospinal fluid) subsequently developed paralysis. The results, therefore, though negative, were inconclusive, providing no evidence either for or against the infectivity of blood in the pre-paralytic stage.

Various animal diseases which were found to be associated with individual human cases were also investigated. Direct association could in the main be established only in such cases where the patients were heavy consumers of raw milk or cream. In some of the cows so associated there were lesions on the udder, locally known as "heifer-pox." While the possibility of this being a virus disease is not excluded, attempts at transmission resulted only in frank pustular lesions, which yielded staphylococci and streptococci on culture. No lesion very suggestive of a known virus disease (cf. cowpox, vesicular stomatitis) was seen.

Field investigation confirmed the reports that cases of paralysis in the domestic animals were of unsuspected frequency. Frank paralysis was seen in pigs, cats, dogs, sheep and turkeys (one). There were also credible reports of paralysis in calves, fowls and ferrets. Eliminating such causes of apparent paralysis as weakness, acute disease such as pneumonia, lesions of the vertebral column, etc., there are definite syndromes, of which paralysis is one symptom, occurring in pigs, cats and dogs.

The paralysis in pigs, which occurs from time to time on various farms in the district (and probably throughout Australia), resembles human poliomyelitis clinically. On one farm in particular, practically all the pigs were affected, some dying in the acute stage, some developing severe residual paralysis of the hindquarters, some few, after showing slight paralysis, recovering completely. The pigs which had marked residual paralyses appeared otherwise well, growing at a normal rate and keeping in good condition. Attempts were made to transfer this condition by intra-cerebral inoculation of emulsions of the cord of affected pigs. Two pigs so inoculated developed suspicious symptoms, including definite pyrexia, an ataxic gait, and transient weakness. The disease complex was not however completely reproduced, and attempts at re-transfer from one of these pigs to other pigs, (as also to monkeys, cats, mice, ferrets and guinea pigs) were unsuccessful. This disease appears to be worth further investigation.

A disease of cats in which one symptom was paralysis was prevalent in Camperdown. There were reports of paralysed cats, and a kitten, with definite paralysis of all four limbs, was obtained from a local store. Intra-cerebral inoculation of two other cats with an emulsion of the nervous system of the affected kitten was followed by a watery discharge from the eyes twelve days later, and by slight but definite nervous symptoms on the fifteenth to nineteenth days. Two subsequent passages have been made with a progressive shortening in the incubation time and increase in the severity of symptoms. This disease is still under investigation, and will be of great interest if it proves to be a disease of cats, not previously reported, due to a neurotropic virus.

There were reports of paralysis in dogs, but not much attention was paid to them, as nervous symptoms are common in canine distemper. However, the extraordinarily high percentages of paralyses in the Skipton district makes one doubt if the disease is canine distemper in its usual form. An opportunity may arise later of investigating this problem.

Material from some of the cases of paralysis in other animals was secured for further study. Transfer of the paralytic condition in sheep was attempted without success.

F. M. Burnet:
"Psittacosis in Australian Parrots." "Medical Journal of Australia," 8th December, 1934.

F. M. Burnet and Phyllis Rountree:
"Psittacosis in the Developing Egg." "Journal of Pathology and Bacteriology" (in the press).

F. M. Burnet:
"An Attempt to Propagate Poliomyelitis Virus on the Developing Egg." "Medical Journal of Australia," 12th January, 1935.

F. M. Burnet:
"Report on Proposed Standard for Staphylococcus Antitoxin." "Quarterly Bulletin of Health," Org. L. of N., Special Number, January, 1935, p. 68.

F. M. Burnet and Dora Lush:
"The Staphylococcal Bacteriophages." "Journal of Pathology and Bacteriology" (in the press).

F. M. Burnet:
"Antigenic Differences Between Related Bacterial Strains: A Criticism of the Mosaic Hypothesis." "British Journal of Experimental Pathology," 1934, 15, 354.

The Biochemical Department.

Mr. Holden has continued his work on the haemolysin of copperhead venom. Using time-concentration and velocity curves, he has studied the effects of lipoid extracts of various erythrocytes, of ovo-lecithin and of calcium chloride. The extracts of ox and sheep cells are inhibitory, while those of horse and rabbit cells are accelerative. Lecithin is a powerful accelerator. The effects of calcium chloride are complex, and include diminution of the latent period and a modification of the shape of the velocity curve from the normal type of an assymmetric sigmoid to one more resembling the curve of a monomolecular reaction.

Using an ultra-violet spectrum photometer, kindly lent by Professor W. A. Osborne, Mr. Holden has commenced the study of the ultra-violet absorption curves of some toxic proteins, notably the snake venoms. The chief characteristic of the absorption curves of Australian venoms appears to be a high absorption without very well marked bands.

Mr. Holden has completed his work, with Professor C. S. Hicks, of Adelaide, on the ultra-violet absorption spectra of certain denatured proteins. The absorption spectrum of a denatured protein depends not only on its native origin, but on the means used for denaturation. This is particularly striking if denaturation is carried out in alcohol or in alkaline solution. Acid denaturation has generally less effect.

Before leaving for England, Miss Freeman completed the work on which she had been engaged for the preceding eighteen months. She studied the effects of admixture of

casein and native ox serum albumin. Mixtures of these proteins, precipitated near the isoelectric point of the former, yield a fraction soluble in 1% sodium chloride solution. An attempt to ascertain by means of nitrogen and phosphorus determinations whether the fraction originated in the casein, or was a mixture of casein with some serum albumin, was unsuccessful.

Specimens of edestin differing in rotatory power having been recorded in the literature, Miss Freeman studied the conditions of preparation of this protein. She found that variations in the method of preparation result in specimens of different rotation which, when once prepared, do not alter with successive crystallisations. No satisfactory evidence could be found that impurities with a high rotation were retained with the crystals of edestin during a series of crystallisations. Suggestions were made for the preparation of specimens of edestin of standard rotation.

H. F. Holden:
"Haemolysis by Australian Snake Venoms. 4. Further Studies on the Haemolysin of the Copperhead." "Australian Journal of Experimental Biology and Medical Science," 1935, 13, 103.

C. S. Hicks and H. F. Holden:
"The Ultra-violet Absorption Spectra of Certain Denatured Proteins." "Australian Journal of Experimental Biology and Medical Science," 1934, 12, 91.

Mavis Freeman:
"Observations on Mixtures of Casein and Native Ox Serum Albumin." "Australian Journal of Experimental Biology and Medical Science," 1934, 12, 155.

Mavis Freeman:
"Observations on the Specific Rotation of Crystalline Edestin." "Australian Journal of Experimental Biology and Medical Science," 1934, 12, 187.

Australian Snake Venoms.

In August of last year we transferred our collection of snakes to the Laboratories Division of the Commonwealth Department of Health. Mr. Tom Eades, who, for some years, has been on our staff as an expert in handling and catching snakes, left us at the same time to join the staff of the Commonwealth Serum Laboratories. We have secured during the last few years sufficient stocks to continue work on the snake venoms, which is still in progress.

The Peripheral Action of Australian Snake Venoms.

Using the methods of amplification devised by Adrian and by Matthews, I have carried out further studies on the peripheral action of Australian venoms on sensory nerve endings. The common Australian snake venoms have a peripheral paralysing action on sensory nerve endings in frogs, though this is less potent than their action on motor nerve endings. Arranging the venoms in order of their activity, this is the same, both for action on sensory and on motor endings. None of the Australian venoms is quite as active as that of the Indian cobra (*Naia naia*), though the venoms of the black snake (*Pseudechis porphyriacus*) and copperhead (*Denisonia superba*) approach it in activity. The recent use of cobra venom for the relief of pain in cancer increases the interest attaching to these observations. Through the kindness of Dr. Moran, I have been able to test commercial preparations of cobra venom by the same methods. These appear to have the same order of toxicity as untreated cobra venom, and it seems possible that preparations of black snake venom might be made which could be used for the same purpose.

The Vaso-depressant Effect of Copperhead Venom.

With Mr. Le Messurier, I have made a further study which is as yet incomplete of the action of this venom upon the blood pressure. Some years ago I showed that this and other Australian venoms have a stimulant action upon plain muscle, which resembles the anaphylactic response of sensitised plain muscle. After a single response to snake venom, the muscle, though it reacts normally to other stimuli, fails to react to a further dose of snake venom. Copperhead venom injected intravenously causes a transitory but profound fall of blood pressure, but, after recovery of the blood pressure, a second vaso-depressant effect cannot be produced. It seemed possible that these two phenomena might be related. However, studies on the isolated perfused rabbit's ear have shown that the peripheral effects of the venom are vaso-constrictor. It remains therefore to be discovered whether this venom has a predominant central vaso-dilator action, or whether the fall of blood pressure following a first injection is due to some disturbance of the coagulation mechanism of the blood.

Antigenic Differences Between the Venoms of the Tiger Snake and Black Tiger Snake.

The further investigation of the antigenic properties of these two Australian snake venoms has been made possible by the preparation of thrombin-free fractions by Mr. Holden. These

were used to immunise rabbits, and the neutralising power of the immune sera against both whole venoms and their fractions was tested. The neutralising titre of monovalent antivenene prepared by the injection of whole tiger snake venom was also determined for these venoms, and for their thrombin-free fractions, as well as for some other common venoms. The antigenic differences between the two venoms are less than those observed between the venom of the tiger snake and that of any other of the Australian colubridae, and are too slight to support the erection of a new species for the melanotic tiger snake. Such differences as exist between the two venoms are independent of the thrombins, being also displayed by the thrombin-free fractions.

C. H. Kellaway:
"The Peripheral Action of Australian Snake Venoms. 4. Action on Sensory Nerve Endings in Frogs." "Australian Journal of Experimental Biology and Medical Science," 1934, 12, 177.

C. H. Kellaway and F. Eleanor Williams:
"Antigenic Differences Between the Venoms of the Tiger Snake (*Notechis scutatus*) and the Black Tiger Snake (*Notechis scutatus var. niger*)." "Australian Journal of Experimental Biology and Medical Science," 1935, 13, 17.

Mussel Poison.

The recent interesting studies from the Hooper Foundation, San Francisco, on outbreaks of mussel poisoning on the Californian coast aroused interest in the possibility of similar occurrences on the Pacific coast of Australia. Mr. D. H. Le Messurier, who has been working in an honorary capacity in my laboratory, with the assistance of Mr. Magary, made a survey of mussels on a portion of the coast between Melbourne and Sydney. Two species of Australian mussels were investigated—*Mytilus planulatus* and *Trichomya hirsuta*—only the former of which is suitable for food. The extensive cultivation of oysters on the portion of the coast investigated appears to have greatly diminished the naturally occurring beds of mussels, and in the region in which oysters are cultivated mussels are not used much for food. Mussels are plentiful in Sydney Harbour, in Port Phillip Bay and at Lakes Entrance, but only in the latter two places are they used for food. In Sydney Harbour, though mussels are plentiful, gathering them has been prohibited owing to the fear of bacterial contamination from deep city drainage systems. No outbreak of mussel poisoning appears to have occurred in Australia. The mussels investigated from numerous places on the coast were non-toxic, except

for a sample of *Mytilus planulatus* obtained from Eden, and of *Trichomya hirsuta* from Bateman's Bay and Lake Burrill. Even these were only feebly toxic, and the toxicity was rather different from that of Californian mussels. It appears unlikely that unless, as in Europe, mussels in enclosed waters suddenly become toxic, any serious outbreak of mussel poisoning will occur in this part of Australia.

Through the courtesy of Dr. Sommer, of the Hooper Foundation, I have been able to make some further analysis of the action upon the nervous system of poison prepared from Californian mussels. This poison has both central and peripheral actions. It is a very powerful curarising agent, and paralyses both sensory and motor nerve endings in extremely low concentrations. On amphibian sensory endings it is active in concentrations of the order of one in a million, and in this respect is much more active than cobra venom. It should, therefore, be worth a trial in low concentrations for combating the pain of inoperable malignancy. Its central action on respiration was studied in animals, in which the motor phrenic discharge was amplified and recorded by a Mathews oscillograph. Large doses cause immediate failure of respiration with cessation of the phrenic motor discharge. Moderate doses cause immediate slowing by central action, accompanied by asphyxia-like effects on the phrenic discharges. These are due partly to the concomitant fall of blood pressure, and partly to inefficient respiratory movement induced by functional block at the motor endings in the respiratory muscles. The fall of blood pressure, which invariably follows the intravenous injection of mussel poison in the intact animal, is attended by vasodilation, chiefly in the splanchnic bed. It is trivial even with very large doses in the decapitate preparation. The poison is, as Leake and his colleagues showed, without demonstrable effect on plain muscle, and its action on the vascular system is probably wholly central.

C. H. Kellaway:
"Mussel Poisoning." "The Medical Journal of Australia," 30th March, 1935.

D. H. Le Messurier:
"A Survey of Mussels on a Portion of the Australian Coast." "The Medical Journal of Australia," 20th April, 1935.

C. H. Kellaway:
"The Action of Mussel Poison on the Nervous System." "Australian Journal of Experimental Biology and Medical Science," 1935, 13, 79.

Platypus Venom.

Mr. Le Messurier and I have also been engaged in a study of the venom of the platypus. For our preliminary studies we have used a specimen of venom collected by Sir Charles Martin about forty years ago. This venom has lost its primary coagulant action upon the blood described by Tidswell, but causes a fall of blood pressure when injected intravenously. Anaesthesia appears to sensitise the animals, increasing the extent of fall of blood pressure, and inhibiting recovery to a normal level of blood pressure.

The poison has no direct effect upon respiration, but indirectly causes changes in the rate and extent of respiration through coronary sinus reflexes. The fall of blood pressure is attended by peripheral vasodilatation. There is some evidence that this is accompanied by paralysis of the vasodilator endings, since we were not able to demonstrate the phenomenon of ergotoxin reversal after administration of platypus venom. The poison caused a fall of blood pressure in the decapitate preparation, and vasodilation could be demonstrated in the isolated rabbit's ear and in preparations of the mesenteric vessels. Finally, it proved to have a characteristic stimulant effect upon isolated plain muscle.

The Incidence of Rheumatic Infections in Australia.

Attention has been focussed in recent years on the low incidence of rheumatic fever in the tropics, and in America recently use has been made of the beneficial effects of tropical climate in the treatment of rheumatic infections. It was hoped that we might be able to collect some information about the incidence of rheumatic fever in Australia. Examination of the vital statistics for Australia shows that the death rate from chronic rheumatism is higher in the southern States than in Queensland. The death rate per million is in Queensland 34, in New South Wales 47, and in Victoria 77. We addressed a questionnaire to all the larger hospitals in Australia and New Zealand in the hope of comparing the incidence of rheumatic fever, chorea, rheumatoid arthritis, and rheumatic heart disease in the different latitudes. Despite the generous assistance of the medical and clerical staffs of the various hospitals, the results of this survey were most disappointing. The scattered population of the tropical areas in Australia, and the lack of hospital records in sparsely settled districts, made an accurate survey impossible. The information obtained, however, confirmed the opinion that rheumatic infections are more common and more severe in southern Australasia than in northern tropical Australia. The figures obtained, however, did not

bear out the contention that rheumatic fever is unknown in the tropics.

ERIC L. COOPER:

"A Note on the Incidence of Rheumatic Infections in Australia," "The Medical Journal of Australia," 8th June, 1935.

The Diagnosis and Treatment of Certain Pulmonary Conditions.

Dr. Cooper has been particularly interested in the pathology and treatment of various lung conditions. At a meeting of the Clinical Society in August, 1934, he presented a number of specimens illustrating lung suppuration, and discussed their pathology.

Dr. Cooper, at a meeting of the British Medical Association, Victorian Branch, gave an interesting communication on the treatment of pulmonary tuberculosis by active measures of various kinds. This was principally a review of the methods that he had observed in use when abroad recently. He has also followed up the results of the radiological and clinical examination of applicants to the nursing staff of the Melbourne Hospital during seven years from 1927 onward. Of 810 women examined clinically and radiologically, 719 showed no abnormality on X-ray examination, and 654 showed neither X-ray nor clinical abnormality. The radiological and clinical signs of tuberculosis are much less common in these young women than in an average series of post-mortems. Active tuberculosis is of rare occurrence in nurses, if the chest is normal before commencement of training. Of the 719 who exhibited no X-ray abnormality, seven later developed pulmonary tuberculosis, approximately 1%. About 1% of the whole series had cervical ribs. Seventeen showed X-ray evidence of scoliosis. Of 47 which presented radiological evidence of tuberculosis, 32 only were followed up. Three of these developed symptoms without change in the appearance of the lungs.

ERIC L. COOPER:

"The Pathology of Lung Abscess." "Melbourne Hospital Clinical Reports," 1934, 5: 65.

"Some Aspects of the Pathology of Pulmonary Tuberculosis and Impressions of Surgical Treatment Abroad." "The Medical Journal of Australia," 19th January, 1935.
"Pulmonary Tuberculosis: Treatment by Active Measures." "The General Practitioner," 1st May, 1935.

"The Radiological and Clinical Findings in 800 Adult Chests." "The Medical Journal of Australia" (in the press).

"The Pathology of Bronchiectasis." "Melbourne Hospital Clinical Reports" (in the press).

Hodgkin's Disease.

Dr. Cooper has reviewed a series of 67 cases of Hodgkin's disease occurring in the Melbourne Hospital during the last ten years. He has analysed these, and discussed their main histological and clinical features with special reference to pruritis and fever. The changes in the circulating blood, the occurrence of nervous lesions, and the involvement of bone by Hodgkin's tissue are discussed. He has described in detail three atypical cases, two of which died of haemolytic anaemia, in the first of which the diagnosis of Hodgkin's disease was made only at autopsy. The third case illustrated compression of the spinal cord by infiltration of Hodgkin's tissue.

ERIC L. COOPER:

"Hodgkin's Disease: Some Clinical Aspects with Special Reference to the Effects upon the Haemopoietic Tissues and the Nervous System." "The Medical Journal of Australia," 11th May, 1935.

Progressive Familial Hypertrophic Neuritis.

Dr. Cooper has also placed on record four cases of this very rare disease, of which, up till 1929, only about twenty cases had been recorded in the literature. The family described consisted of a woman fifty-five years of age and three sons aged 28, 24 and 21 years. The mother of the female patient was said to have had similar wasting of the peripheral portions of all four limbs. All the members of this family had marked wasting and loss of power in the lower limbs, extending as far as the junction of the lower and middle thirds of the thighs, and of the distal portions of the forearm and hands with anaesthesia of glove and stocking type.

ERIC L. COOPER:

"Progressive Familial Hypertrophic Neuritis (Déjerine-Sottas)." (In the press).

Portal Thrombosis.

Dr. Cooper has reported a case of six years' duration, and has discussed the morbid anatomy and aetiology of the condition, the significance of chronic infection in the portal area,

and of cirrhosis of the liver and the association of muscular hypertrophy with fibrosis of the portal vein in phlebosclerosis and pylethrombosis.

ERIC L. COOPER:
"Portal Thrombosis." "Melbourne Hospital Clinical Reports," 1934, 5, 33.

The Sterility of Surgical Suture Material.

Miss F. E. Williams has continued to devote a good deal of attention to this subject. She has compared various ways of sterilising horse-hair, and has reported on the methods in use in the Royal Melbourne and some other hospitals. Mechanical cleaning by scrubbing in weak (0.25%) soda solution, followed by boiling in water for short periods upon three successive occasions, appears to be most satisfactory.

Bacteriology and Clinical Pathology Department.

At the end of July, 1934, Dr. Lucy Bryce resigned from the position of Bacteriologist, which she had ably filled since 1928, to take a post at another hospital. Dr. Gardner was appointed to the senior position, and in October Dr. J. I. Hayward, who had been for some months on the resident staff of the Hospital, became Resident Bacteriologist.

The work of the department, as hitherto, has embraced bacteriology, serology, and haematology, together with skin tests for allergy. This has involved the performance of 13,376 tests for 4342 in-patients and 4642 out-patients.

Tuition in clinical pathology has again been given to fifth-year medical students, but their increasing numbers is a tax on the limited accommodation available, and on the time of the staff.

Dr. Gardner has co-operated with Dr. Ian Wood, with the sanction of the Honorary Medical Staff, in the investigation of some severe cases of pernicious anaemia, and their response to treatment with large doses of liver extract prepared for intramuscular injection. This proved to be a most satisfactory method, both from the point of view of the patient and the clinician. In several cases two injections, without any adjuvant treatment, were sufficient to restore the patient to a normal blood level.

Dr. Hayward is investigating the haemolysin production by streptococci.

The dark ground apparatus, which was made available through the generosity of the Box Hill and Mont Albert

Auxiliary in 1934, has been much appreciated, and has been the means of increasing the efficiency of the department in this branch of the work.

Miss F. E. Williams has again been responsible for the hydatid, gonococcal and bilharzial complement fixation tests, and has, in addition, given much appreciated help with the Wassermann tests when the department was shorthanded. Dr. Wright-Smith has carried out the Casoni test when necessary.

Hilda J. Gardner and Ian J. Wood:
"Massive Dosage of Intramuscular Liver Extract in the Treatment of Pernicious Anaemia." "Medical Journal of Australia," 4th May, 1935.

Biochemistry and Basal Metabolism.

The demand for biochemical work has again shown an increase this year, and Miss Splatt and her assistant have had a very active year. The estimation of calcium and phosphate in the blood as a diagnostic measure has been used more widely during the past year than previously. The rapid growth of the diabetic clinic has resulted in increased use of the glucose tolerance test to establish the diagnosis of patients, and blood sugar estimations at regular intervals to check their progress. Owing to the great benefits obtained from treatment, this is perhaps one of the most practical sections of our work.

In conjunction with Dr. Ian Wood, investigations into the biochemical changes in the blood during the administration of continuous intravenous saline have been carried out. This work is still in progress.

The basal metabolic determinations continue to be a heavy call on Miss Splatt's time, though this year there have been relatively few cases of exophthalmic goitre.

Electrocardiography.

Mr. E. Hughes is in charge of this department. During the past year he has investigated 640 patients. The Cambridge string galvanometer instrument has been thoroughly overhauled and modernised, but most of the work has been done with the portable Matthews instrument.

Morbid Anatomy.

During the year 415 autopsies were performed. The biopsy examinations have numbered 923. The microscopic and macroscopic photography has been done by Miss Wischusen. Owing to the kindness of the Box Hill and Mont Albert Auxiliary, it

has been possible to equip the photographic department with apparatus for the photography of patients and of macroscopic specimens. This includes a camera and photographic lighting and screens and some other accessories, and the room in which the work is done has been equipped with light-proof shutters. This represents a very great advance in our facilities for work of this kind in the Hospital, and we are very greatly indebted to the ladies of the Auxiliary, whose generosity has made it possible.

Museum.

Many new specimens have been added, including haemangioma of the brain, neurocytoma of the adrenals, Riedel's thyroiditis, adenocarcinoma of the sweat glands. We are indebted to Dr. C. H. Mollison, Mr. Basil Kilvington, Mr. Alan Hailes, and Dr. R. W. Chambers for gifts of specimens. The Museum is being widely used by the honorary staff, graduates doing higher degrees, and students.

Teaching.

In the absence in England of Dr. Wright-Smith, Dr. Cooper gave a course of lectures in bacteriology to nurses. Dr. Wright-Smith gave a course of lectures in pathology to fourth-year students in January and February of this year. Dr. Wright-Smith is giving fortnightly demonstrations of pathological material to the honorary staff.

Last year I conducted tutorial classes on behalf of the Melbourne Permanent Committee for Post Graduate Work for the Primary Fellowship examination, which was held in November, 1934.

At the end of May and beginning of June of this year I gave a series of four lectures on applied physiology at Sydney for the Sydney Permanent Committee for Post Graduate Work.

I also gave an address in July of last year before the Royal Australasian College of Surgeons, in which I summarised some of the recent work on intestinal obstruction.

The Library.

Our thanks for the gift of journals and books are due to the following:—L'Académie Royale de Medecine de Belgique; The Cancer Research Committee, Sydney; The Commonwealth Department of Health; The Connaught Laboratories; The Council of Scientific and Industrial Research; Miss Danks; Mr. Dobell, F.R.S.; Captain S. R. Douglas, F.R.S.; The London

Hospital; The Medical Research Council; The Middlesex Hospital Medical School; New York State Department of Health, Division of Laboratories and Research; Otago University Medical School; The Rockefeller Institute; The Royal Prince Alfred Hospital, Sydney; The Royal Society of New South Wales; La Société Royal des Sciences Médicales; The South African Institute for Medical Research; The University of Harvard, Department of Tropical Medicine; The University of Pennsylvania, Department of Pathology; The University of Tomsk.

CHARLES H. KELLAWAY,
Director.

Walter and Eliza Hall Institute of Research in Pathology and Medicine

FINANCIAL STATEMENT FOR THE YEAR ENDED 30th JUNE, 1935.

RECEIPTS.

To Balance brought forward from 30th June, 1934				£2,048	0	7
„ Trustees, Walter & Eliza Hall Trust	£3,200	0	0			
„ University of Melbourne (1934 and 1935)	1,500	0	0			
„ Felton Bequest Committee	300	0	0			
„ A. M. Nicholas	250	0	0			
„ Trustees, late Anthony Mackie	100	0	0			
„ Estate late Edward Naylor	19	8	11			
„ Trustees late T. J. Sumner	8	0	0			
„ The Danks Trust	14	5	0			
„ The Elsie Marion Carty Fund, Materials, etc.	50	0	0			
„ The Royal Australasian College of Surgeons	17	10	0			
„ Dr. Basil Kilvington	6	6	0			
„ Commonwealth Government (Refund re Venoms)	183	0	0			
„ Melbourne Hospital	146	2	2			
„ Fees Received and Proceeds of Materials Supplied	206	6	1			
„ Interest	61	16	8			
„ Refund, Fittings and Equipment	9	10	10			
				6,072	5	8
				£8,120	6	3

EXPENDITURE.

By Salaries and Wages	£3,891	12	0			
„ Materials	320	10	5			
„ Apparatus	44	1	2			
„ Sundries	104	11	10			
„ Repairs to Apparatus	14	14	3			
„ Repairs to Buildings	21	9	11			
„ Publications	80	4	11			
„ Fittings and Equipment	4	19	5			
				£4,482	3	11
„ Bio-Chemical Department				330	2	6
„ Library Account				50	4	2
„ Balance—						
Investments	1,875	0	0			
Cash—Agent-General, London	54	7	4			
Secretary's Advance Account	100	0	0			
Bank of New South Wales	1,228	8	4			
				3,257	15	8
				£8,120	6	3

THE ELSIE MARION CARTY FUND—CAPITAL ACCOUNT.

To Payment on Account of Bequests ..	£350	0	0	By Investments	£350	0	0

THE ELSIE MARION CARTY FUND.

To Balance brought forward from 30th June, 1934	£310	7	6	By Salaries	£175	0	0
„ Trustees, E. M. Carty	184	9	11	„ Materials, Publications, etc.	50	0	0
„ Refund Bank Account Fee	0	5	0	„ Premium on Commonwealth Bonds ..	11	16	3
				„ Balance	258	6	2
	£495	2	5		£495	2	5

BIO-CHEMICAL ENDOWMENT ACCOUNT.

To Balance brought forward from 30th June, 1934	£8591	10	3	By Bank Charges				£1	12	6
„ Interest on Investments	414	12	0	„ Interest Transferred to Bio-Chemical Department Account				412	19	6
				„ Balance—						
				Investments	£8589	12	6			
				Bank of New South Wales	1	17	9			
								8,591	10	3
	£9,006	2	3					£9,006	2	3

BIO-CHEMICAL DEPARTMENT ACCOUNT.

To Interest Transferred from Endowment Account	£412	19	6	By Salaries and Wages	£743	2	0
„ Transfer from Income Account	330	2	6				
	£743	2	0		£743	2	0

LIBRARY ACCOUNT.

To Balance brought forward from 30th June, 1934	£2,030	0	0	By Books, Journals and Bookbinding	£145	13	2
„ Interest on Investments	95	9	0	„ Balance—Investments	2,030	0	0
„ Transfer from Income Account	50	4	2				
	£2,175	13	2		£2,175	13	2

VIRUS ACCOUNT.

To Commonwealth Government	£1,000	0	0	By Salaries and Wages	£807	5	7
„ Rockefeller Foundation	1,000	0	0	„ Materials, Apparatus, Equipment and Sundries	1,155	15	11
„ H. G. Adams, Refund of Hire of Van, Camperdown	25	0	0	„ Balance, Bank of New South Wales	61	18	6
	£2,025	0	0		£2,025	0	0

C. H. MOLLISON, Honorary Treasurer.

I have examined the Books, Vouchers and Securities of the Institute for the year ended 30th June, 1935, and I certify that in my opinion the Statement of Receipts and Expenditure is a correct statement as revealed by the books of the Institute. I have obtained all the information and explanations I have required.

W. H. JARVIE, F.C.A. (Aust.).